ROAD & BRIDGE PRECONSTRUCTION ENGINEERING

Where are we today?

Review of Servicewide Practices
&
Chief's Action Plan

EM-7720-3

JULY 1977

Washington Office

FOREST SERVICE
U.S. DEPARTMENT OF AGRICULTURE
Washington, D.C. 20013

FOREWORD

Five years ago the "National Forests in a Quality Environment Action Plan" was published. We have made much progress since then. Relative to roads, that action plan concentrated heavily on close supervision of construction and tightened enforcement of contract provisions to obtain high quality performance in road building. Such emphasis has brought about improvements. Now, emphasis and attention must be given, as well, to the preconstruction phase of our road program, as illustrated in this Activity Review of Road and Bridge Preconstruction Engineering.

The results of this Activity Review of Road and Bridge Preconstruction Engineering lead me to three primary conclusions:

1. Line Officers are having difficulty in documenting their resource management objectives in terms that are clear, meaningful, and useful to Engineers.

2. There is insufficient documentation being made of the decision-making and communication process between Line Officers and Engineers.

3. A deficiency exists in the knowledge and skill level being applied toward the task of fitting road design components to resource management objectives and the development and presentation of alternatives.

We must improve our performance in these areas. Field units need to concentrate more on giving attention to informing the timber industry, conservation groups, and the public of the reasons for our various road decisions with the objective of gaining their understanding.

Our goal is to develop transportation facilities that have the proper blend of safety, environmental protection, economy, and function. The Forest Service is not meeting this goal in every case and additional emphasis and action are needed. This Activity Review of Road and Bridge Preconstruction Engineering indicates that some "overbuilt" and "underbuilt" roads have occurred.

I am in full agreement with the attached Action Plan for our Road and Bridge Preconstruction Engineering Activity and expect all those concerned to give

this their full attention and best efforts. We must work toward eliminating "overbuilt" roads as an issue in the Forest Service. However, this emphasis should not be used as an excuse for developing "underbuilt" roads.

John R. McGuire

JOHN R. McGUIRE
Chief

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CHIEF'S ACTION PLAN

OBJECTIVE NO. 1:	*Resource management objectives, transportation alternatives, and their relationships shall be adequately defined and analyzed by the Forest Service.*

Washington Office Actions	Responsibility at W.O.	Target Date
1. The Chief shall issue the necessary policy and detailed instructions in FSM Titles 7700 and 8400 to clarify the relationship between resource management objectives and transportation preconstruction alternatives.	Engineering and Land Management Planning	1/1/78

Regional Actions	Responsibility at R.O.	
1. The Regional Foresters shall take action to require the Forests to relate transportation alternatives clearly to resource management objectives in the EAR process.	Engineering and Land Management Planning	11/1/77
2. The Regional Foresters shall provide to the Forests the necessary training, target dates, and review to meet the requirements established in the WO action above.	Engineering and Land Management Planning	1/1/79

OBJECTIVE NO. 2:	*The Forest Service shall use and document decision analysis techniques (particularly economics) in making evaluation of resource benefits relative to transportation costs.*

Washington Office Actions	Responsibility at W.O.	Target Date
1. The Chief shall develop a decision analysis guide (with emphasis on economics) for use by preconstruction engineering personnel.	Engineering and Policy Analysis	4/1/78

Regional Actions	Responsibility at R.O.	
1. The Regional Foresters shall provide training and certification of preconstruction engineering personnel in applying the guide developed in the WO action above.	Engineering	4/1/79
2. The Regional Foresters shall take action to require the Forests to use decision analysis principles (especially economics) in their preconstruction engineering.	Engineering	11/1/77

OBJECTIVE NO. 3:	*Provide the level of quality of design of transportation facilities so that the blend of safety, environmental protection, economy, and function needed is obtained.*

Washington Office Actions	Responsibility at W.O.	Target Date
1. The Chief shall review and revise the FSM and Road Design Handbook as necessary to provide mandatory standards that are cost-effective.	Engineering	7/1/78
2. The Chief shall issue a policy statement that requires the Forest Engineer to approve road and bridge designs as technically adequate before they can be constructed.	Engineering	11/1/77
3. The Chief shall issue a policy statement that requires all road designs to be developed under the direct supervision of a designer certified in advanced road design.	Engineering	1/1/78

Regional Actions	Responsibility at R.O.	
1. The Regional Foresters shall perform annual activity reviews of a representative sample of road design projects. These shall include an evaluation of the technical supervision and critique provided.	Engineering	11/1/78
2. The Regional Foresters shall require that Forest Engineers perform an activity review of a representative sample of road design projects each year.	Engineering	11/1/77

OBJECTIVE NO. 4: Use of timber purchaser credits shall be in accordance with PL 88-657.

Washington Office Actions	Responsibility at W.O.	Target Date
1. The Chief shall review and revise FSM Titles 2400, 6500, and 7700 to conform to PL 88-657. Action shall be coordinated with the National Forest Management Act of 1976.	Engineering, Timber Management, and Fiscal and Accounting	1/1/78

Regional Actions	Responsibility at R.O.	
1. In any relevant Fiscal, Timber, or Engineering activity reviews, the Regional Foresters shall include the use of timber purchaser credits as a review item.	Engineering, Timber Management, and Fiscal and Accounting	11/1/77

OBJECTIVE NO. 5: Determine how FR&T funds are being used within the preconstruction activity and use these funds effectively.

Washington Office Actions	Responsibility at W.O.	Target Date
1. The Chief shall establish, possibly through the PAMARS System, an accounting procedure which identifies the various elements of preconstruction engineering by project.	Engineering, Program Development and Budget, and Fiscal and Accounting	7/1/79

Regional Actions	Responsibility at R.O.	
1. The Regional Foresters shall take action to assure that preconstruction funds are used effectively to meet Servicewide (national) direction. This concern shall be addressed in all relevant activity reviews.	Engineering and Fiscal and Accounting	11/1/77
2. The Regional Foresters shall sample the Forests and identify how preconstruction FR&T funds are being expended.	Engineering and Fiscal and Accounting	1/1/79

OBJECTIVE NO. 6: Strengthen use of and commitment to the directives system.

Washington Office	Responsibility at W.O.	Target Date
1. The Chief shall remove inapplicable non-policy material from FSM 7700 and coordinate with other FSM Titles as necessary. FSH 7709.11 shall be revised to reflect this change.	Engineering	1/1/78
2. The Chief shall strengthen the use of, and commitment to, the directives system by emphasizing specific functions, such as: a. Reviews, audits, and functional assistance trips, b. Training plans, c. Monitoring performance evaluations.	Policy Analysis and Engineering	11/1/77

Regional Actions	Responsibility at R.O.	
1. The Regional Foresters shall review and revise Regional FSM and FSH supplements to correspond with the WO revisions and to eliminate duplication.	Engineering	7/1/78
2. The Regional Foresters shall strengthen the use of, and commitment to, the directives system emphasizing specific functions, such as: a. Reviews, audits, and functional assistant trips, b. Training plans, c. Monitoring performance evaluations.	Regional Staff Directors	11/1/77

OBJECTIVE NO. 7: Develop valid cost estimates for emergency and special funding programs.

Washington Office Actions	Responsibility at W.O.	Target Date
1. The Chief shall develop direction which gives emphasis to the time, processes, and estimating stages needed to arrive at accurate cost information for special programs.	Engineering and Program Development and Budget	4/1/78

Regional Actions	Responsibility at R.O.	
1. The Regional Foresters shall develop an action plan which identifies processes for estimating costs of repairing road and bridge damage caused by natural disasters, such as floods, fire, earthquakes, etc.	Engineering	1/1/78

ACTION PLAN FOLLOW-UP

The WO Director of Engineering and the Regional Foresters shall submit to the Chief special progress reports on the Action Plan accomplishments. These reports shall be due on January 31, 1978, January 31, 1979, and January 31, 1980. The Director of Engineering shall review and consolidate these reports and make recommendations for improvement to the Chief within 30 days of receipt.

Action Plan Coordinator

To assist the various WO Staffs and the Regions in accomplishing their assigned responsibilities, the WO Transportation Systems Preconstruction Engineer, Beryl Johnston, will serve as coordinator for the Chief's Action Plan.

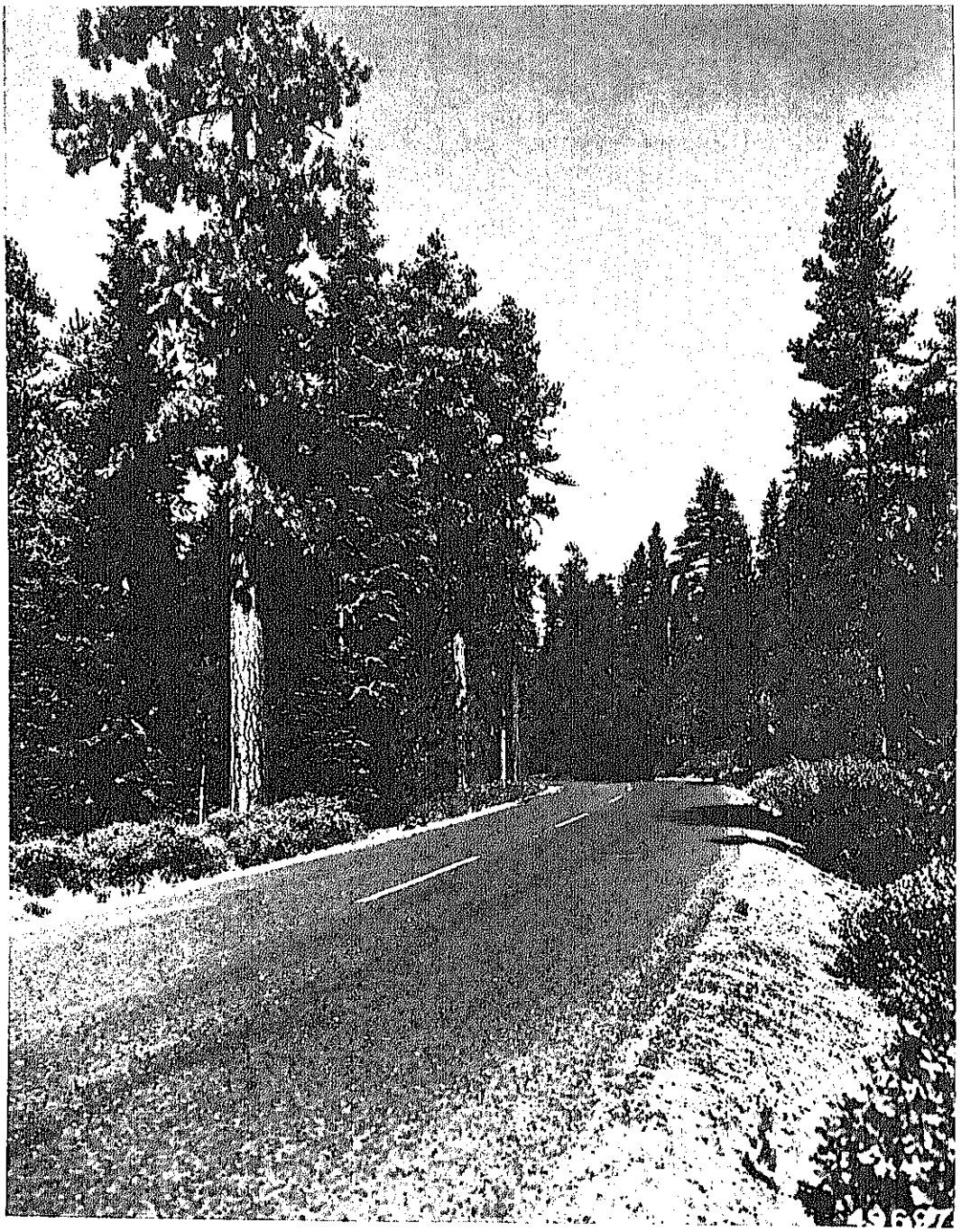


Figure 1. *Arterial Scenic Recreation Road, R-6*
The Cascade Lakes Highway at a point where it passes through a stand of old growth ponderosa pine on the Deschutes National Forest in Oregon. This section has good curvilinear alignment over flat terrain. Another section, however, has a very long, esthetically displeasing tangent.

INTRODUCTION

This report is a Review of the Road and Bridge Preconstruction Engineering Activities in Regions 1, 6, and 9. Within these Regions, preconstruction activities are performed which are representative of such work practices Servicewide. The Review was made in accordance with objectives and guidelines of the *Forest Service Internal Management Review System* (revised, September 1975).

Transportation System Preconstruction Engineering includes the following activities:

1. Design Standard Prescription (the design criteria which is usually developed in the EAR).

2. Route Reconnaissance and Selection.

3. Route Location.

4. Geotechnical and Terrain Surveys.

5. Facility Analysis (the determination of the blend of safety, environmental protection, economy, and function needed).

6. Geometric and Structural Section Design (computations, specifications, plans, and cost estimates).

This activity was selected for review because of recent significant changes in Forest Service preconstruction work. Some units have delegated design work to subordinate echelons. Others had increased non-Forest Service preconstruction work. All units have experienced an increase in engineering workload for timber harvest. In addition, recent audits, reviews, and Congressional inquiries have raised concern that the facilities do not meet needs.

Aspects of the preconstruction engineering activity were discussed recently in audits of Regions 1, 2, 6, and 8 and in the 1976 *Overview of Timber Sales and Related Engineering Activities*. The Appendix includes a list of these reports.

Specific procedures and concerns to be included in the review plan were developed at a Milwaukee meeting with the involved Regions. The plan was approved by the Deputy Chief for the National Forest System on April 26, 1976.

Using criteria specified in the plan, the Regions selected 28 projects for review. The locations and dates of field reviews were:

Field Reviews	Number of Projects
Region 9--July 12-25, 1976	
Green Mountain National Forest	2
Allegheny National Forest	3
National Forests in Missouri	3
Ottawa National Forest	3
Region 1--August 9-20, 1976	
Idaho Panhandle National Forest	3
Kootenai National Forest	2
Nezperce National Forest	2
Lolo National Forest	2
Region 6--September 6-17, 1976	
Deschutes National Forest	2
Gifford-Pinchot National Forest	2
Malheur National Forest	2
Siskiyou National Forest	2

The 28 projects receiving full review were facilities already constructed or under construction. This allowed for an assessment of how the design fit its intended use. However, the preconstruction processes were accomplished at least 3 years ago and field units have since improved planning and design processes. These improvements were observed in spot reviews of later designs and related documentation. Further follow-up reviews by the Regions should look at current preconstruction processes. An additional 30-plus projects were observed or discussed to some lesser extent during the field reviews.

Characteristics of projects reviewed include:

One-lane roads costing as little as $2,000 a mile.
A one-lane road costing $250,000 a mile.
Two-lane surfaced and unsurfaced roads.
Permanent and temporary bridges.
Purchaser-designed projects.
Recreation as well as timber projects.
Projects designed using manual and computerized design systems.
Projects designed using photogrammetry.
Projects designed by district engineers, zone engineers, and Forest-wide design engineers.
Projects designed by FHWA or consultants.

The review team included Washington Office Staff and a representative of each involved Region as a full participant:

Charles Weller	- Assistant Director of Engineering, WO Team Leader
Edward H. Stone II	- Landscape Architect, WO
George A. Roether	- Timber Management Specialist, WO
Lawrence D. Bruesch	- Highway Structures Engineer, WO
Marion E. Unruh	- Construction & Maintenance Engineer, WO
Willard Clementson	- Highway Safety Engineer, WO
Victor M. DeKalb	- Planning & Operations Engineer, WO
George Scherrer	- Assistant Director of Engineering, R-9
Leland C. Landman	- Assistant Director of Engineering, R-1
Loren D. Evans	- Regional Preconstruction Engineer, R-6

In addition to the team, representatives from Regions 3, 5, and 8 helped analyze the findings and develop several alternative actions. These representatives were:

John Lamb	- Assistant Director of Engineering, R-8
Levi Allen	- Regional Preconstruction Engineer, R-5
Ronald Van Natta	- Regional Preconstruction Engineer, R-3

The review team's preliminary report was developed by Vic DeKalb and Larry Bruesch. The report and alternative actions were transmitted to the Regions for comment. The report and action plan were finalized by Beryl Johnston, WO Preconstruction Engineer.

In the three Regions reviewed, the team conferred with the Regional Forester or Resource Deputy and staff, Forest Supervisor and staff, and District Rangers and staff. The Engineering Staff was always represented. In addition, at least half of the individuals accompanying and conferring with the team were line and resource officers.

The review consisted of three steps: Office review, field review, and conclusion analysis (see Appendix).

The office review was conducted before going to the field. This consisted of determining data needs, developing information systems for data collection and analysis, reviewing directive material, selection of projects, and reviewing project documentation (particularly, environmental analysis reports and supporting documents).

The field review was primarily to collect information about the selected roads and/or bridges on each unit.

The responsible officer and his principal staff were interviewed to determine the type of engineering organization and training, the practices for relating road design criteria to resource management needs, the "preconstruction" workload on the Forest, and to identify any barriers that are reducing the effectiveness of the activity. After the office interview, the team reviewed two or three projects on the ground using a comprehensive assessment sheet to assure consistency of data collected between units.

The projects were reviewed to compare management prescriptions with the design standards and the actual traffic use. Problem causes were discussed. In most cases, the District Ranger accompanied the team and participated in discussions on management practices, direction, and concerns. Wherever possible, the review team checked private logging company roads. The team also interviewed two timber purchasers and a county commissioner. Upon completion of work in a Region, an exit interview was held with the Regional Forester or the Resource Deputy and staff.

The final phase consisted of analysis and evaluation of the data collected during the previous activities. It was analyzed for Servicewide applicability as well as for the Regions visited. The findings and problems were also presented and discussed with Regional Engineers at their fall meeting. A final review of findings and problems and development of alternative actions was made by the team members and representatives from Regions 3, 5, and 8. This report is based on these discussions.

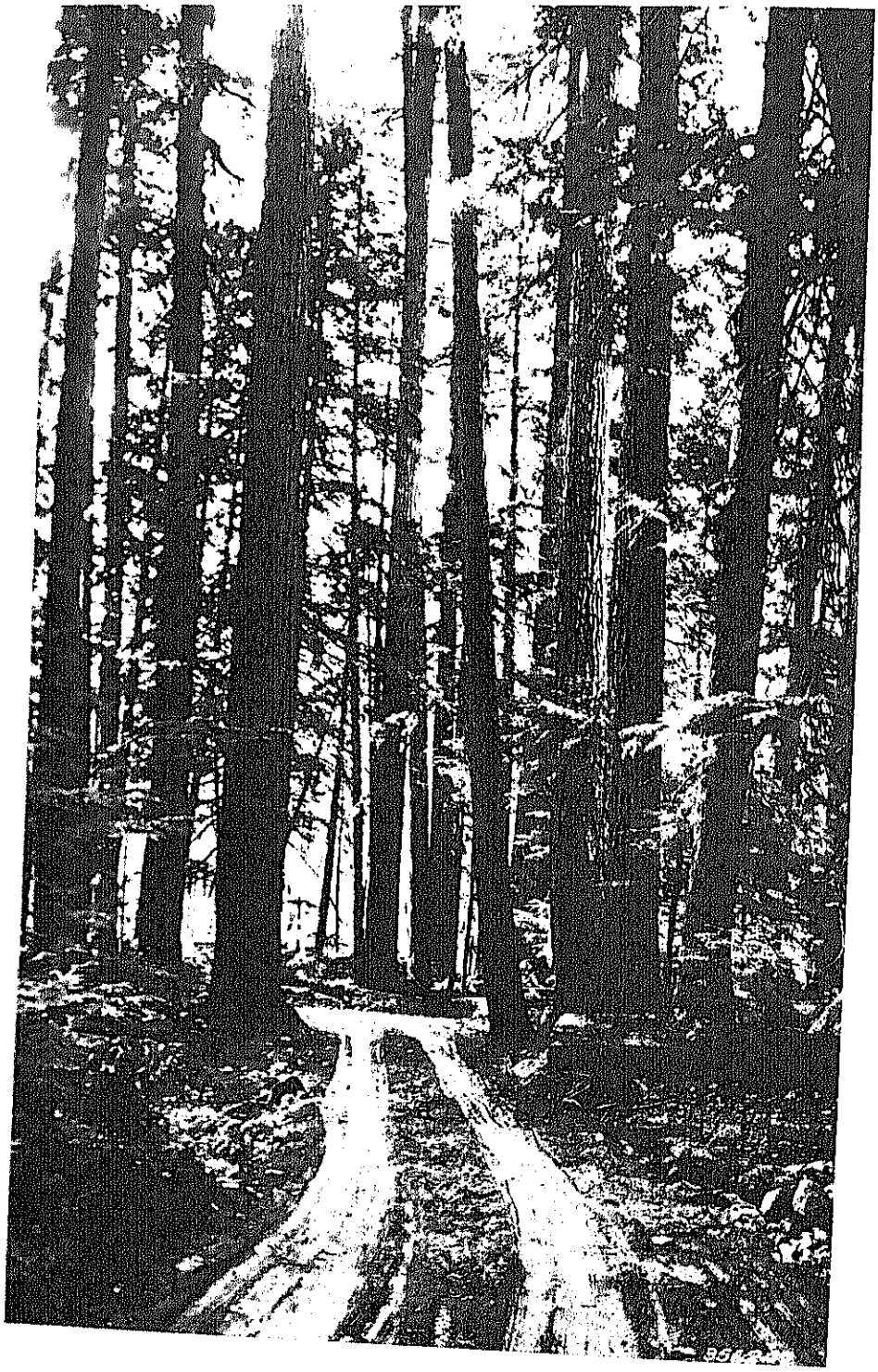


Figure 2. Local Timber Sale Road, R-6.
A low standard timber access road on the Gifford Pinchot National Forest in Washington.

SUMMARY OF REVIEW

BACKGROUND

To provide resources for use of the people of the United States, the Forest Service constructed or reconstructed 9,800 miles of road in 1976. These roads provide access to commercial resources, and to non-commercial resources such as hunting, fishing, camping, hiking, and solitude.

The construction, maintenance, operation, and use of the Forest Service road system is a large, complicated undertaking. Preconstruction engineering produces the designs, and these designs can have beneficial influences on future expenditures, the environment, and human enjoyment, if properly engineered.

Typical Forest Service investments for road construction and reconstruction are shown in table 1. From the limited data available, the team found preconstruction engineering costs, when averaged by Regions, varied from 10 to 33 percent of the cost of project construction and/or reconstruction.

Table 1.--Estimated National preconstruction costs.

Fiscal year	Number of miles constructed or reconstructed	Construction cost in millions of dollars	Estimated preconstruction cost in millions of dollars
1974	8,000	230	50
1975	8,500	270	60
1976	9,800	295	65
1980*	10,200	380	85

**RPA Estimate*

Roads and bridges designed by Forest Service engineers range from narrow fire access roads to wide, two-lane, high-speed highways that carry loads half again as heavy as State highways. Conditions such as topography, water, biologic environments, climate, soil, and traffic vary widely.

Before 1969, this activity was often accomplished with only general consideration of environmental-transportation integration, public involvement,

or interdisciplinary analysis. More careful investigation of proposed roads and their design has been required recently. This is caused by the passage of the National Environmental Protection Act and an increased realization that natural resources must be used with full recognition of the consequences.

The review study plan states that during the last 3 years, the following changes have taken place in Forest Service road and bridge design:

1. Responsibility for complex road designs has been reassigned to National Forests and, in some cases, to Ranger Districts, zones, or technical centers.

2. Several Regions have reduced their bridge design staffs yet still handle the same workloads by use of consultants and other agencies.

3. Design for public works road construction has diminished while the workload for timber sale contracts has increased.

In addition, there were indications from the public, Congressional representatives, field trips, and similar sources that:

1. Roads do not satisfy perceived user requirements.

2. The costs of designing and constructing some roads are excessive.

3. Road systems and harvest systems are not adequate.

4. Geotechnical investigations are not adequate.

5. Road development is providing unacceptable environmental impact.

6. Integration of road and bridge design and long-range land use or functional planning is often lacking.

7. Design requirements are not consistent with PL 88-657 and other laws and regulations applicable to Forest roads.

OBJECTIVE

As a result of the above considerations, a formal objective for this review was developed:

To determine if current direction and established standards for road and bridge preconstruction procedures are adequate to assure that a facility meets management objectives; and,

To develop an action plan which will correct the deficiencies found and improve performance and effectiveness at all organizational levels.

ISSUES AND CAUSES

The findings of this review indicate that the nine problems can be grouped under three issues as follows:

Issue No. 1: Communications, Analysis, and Other Documentation Need Improvement.

Problem 1
Resource management objectives, transportation alternatives, and their relationships are not being analyzed and defined adequately.

Issue No. 2: Design Procedures and Quality of Design Need Improvement.

Problem 2
There is a Servicewide weakness in the understanding, use, and documentation of rational decision analysis; in particular, economic analysis.

Problem 3
Inadequate design and design procedures have caused unsatisfactory facilities.

Problem 4
The Forest Service is designing and building roads and bridges that may cause unacceptable injury and property damage to users.

Issue No. 3: Management Activities That Affect Preconstruction Practices Need Improvement.

Problem 5
Numerous inconsistent uses of purchaser credit cause questionable road financing practices.

Problem 6
The expenditure of preconstruction engineering funds, as shown by year-end obligations, exceeds direct expenditures for survey and design by a significant and unexplained amount.

Problem 7
The directives system for road and bridge preconstruction is often ignored and misinterpreted and does not always meet field concerns.

Problem 8
It will be extremely difficult to reduce deferred survey and design backlog and still maintain existing production goals.

Problem 9
Crisis planning for projects to be financed with emergency or special funds often results in underestimating costs.

It is noted that the above problems do not specifically discuss "overbuilding." "Overbuilding" means different things to different people. It can be described as a road condition which the observer considers to be too expensive or will have too great an impact on the environment. It may also mean "too many roads." In the purchaser's eye, road surfacing may be "excessive" while the conservationist would perceive the same road as "overbuilt," because of the damage to the visual resource. An analysis might show that the road was necessary to serve the resource adequately and was designed and developed with an optimum balance between costs and environmental damage.

The "overbuilding" issue has been raised with increasing frequency and at such levels that the Chief directed the team to give it special emphasis. The reviewers observed a wide range of design and construction from the very minimum of ground disturbance to what is essentially a continuation of a State secondary system. Some of the facilities were overbuilt; some were underbuilt. The majority were constructed to the appropriate standards. There is room for improvement, however, and steps to do this are included in the alternatives and action plans which follow. A more complete discussion of the findings and comments concerning "overbuilding" is included in the Appendix.

Figure 3. Private Logging Road, R-6. Gilchrist Timber Company, Gilchrist, Oregon. The travel width is over 40 feet from ditch line-to-ditch line. The surface is native pumice and the centerline elevation lies below the surrounding flat terrain.

Causes vary for the issues listed above. They include expediency, lack of direction, lack of knowledge, poor use of professional skills, resistance to change, or failure to understand priorities.

In analyzing the tradeoffs between resource needs and facility standards, it was found that the Environmental Analysis Reports (EAR's) were not complemented by an accompanying analysis that evaluated how different facilities or standards would accomplish the EAR objectives. FSM 8310 has very clear direction on what is needed in an EAR, but the directives system does not clearly describe and relate an engineering analysis to the EAR. As discussed in "Exemplary Achievements" the quality of EAR's and supporting documents has increased during recent years. There is still a significant need for improvement. It is, therefore, recommended that the directives system require an engineering analysis, when an engineered facility is involved, as part of the EAR process.

The findings show a deficiency in applying systematic and complete engineering practices to road management and particularly to the location survey and design of roads. It is recommended that transportation alternatives will be given rigorous evaluation, including economic analyses.

Performance standards should be developed and training given to improve skills. In developing alternatives, the team has tried to balance short term action activities with long term actions. Job performance requirements for preconstruction engineering will be developed by next year. Testing and training will take 2 to 3 years. A continuous and increased level of effort will be required to maintain the skills needed. This should provide an improvement in preconstruction engineering.

Along with proper direction, it is important to emphasize accountability. Journeyman engineers should be expected to evaluate a job and to do that analysis necessary to provide support to the manager. Individual performance must be rated with the notion that a responsible engineer should produce good design if given good criteria. Engineers should also be expected to work with line officers and other technical specialists in developing criteria and objectives which provide latitude for creative design yet clearly define the desired result. This interaction needs considerable improvement.

Management actions have considerable influence on the facility that is developed. Two actions taken in recent years have exactly opposite logic. From 1973 through 1975, some Regions obligated preconstruction funds at a high level per mile of road constructed, yet there was such a strong need for survey production that purchaser engineering was used. Cost-effective programing and operations would have resulted in more funds available to meet national objectives.

The high cost per mile expenditure of preconstruction funds can be partially explained by practices such as financing work with little relation to preconstruction or by surveying and designing roads which will probably not be constructed. Specific reasons for the high level of obligations need further study. This situation causes significant amounts of financial and human resources to be wasted. It reduces Forest Service capability to meet commitments to Congress. The reviewers feel that one cause is a failure of some managers at the Forest and District level to recognize national direction as

a high priority with consequent expenditures on projects or in program areas that are low in national priorities. Action must be taken to be sure that national priorities are recognized and followed by all units.

In general, the directives system provides adequate direction and guidance, but two major areas of deficiency exist which materially affect operations. One involves the preparation and maintenance of directives material; the other, commitment on the part of the intended user. The reviewers believe that the scope of this issue goes far beyond this activity review and relates to the discussion in the preceding paragraph. For purposes of this review, improvement can be realized by a general revision of FSM 7700, FSH 7709.11, and related Regional supplements.

CORRECTIVE ACTIONS

Corrective actions are listed with the discussion of each finding.

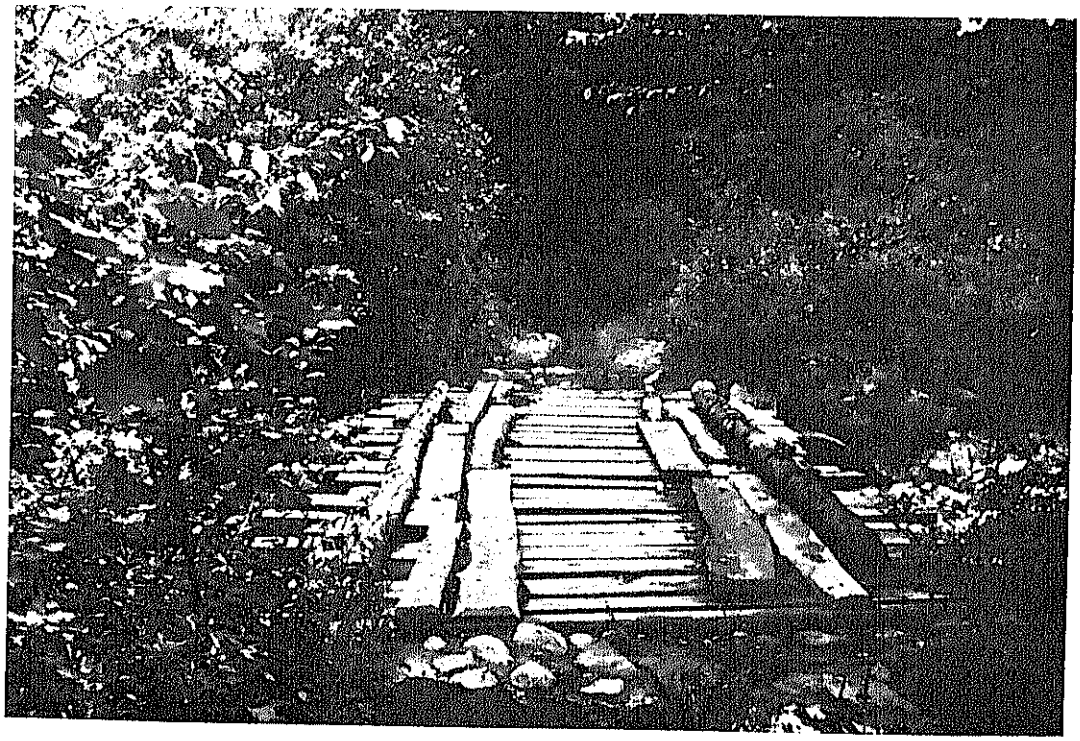


Figure 4. West Branch of Deerfield River Bridge, R-9
An old, existing, unsafe, single-lane bridge. This has been replaced with a new bridge downstream from this location (see figure 8) on the Green Mountain National Forest.

EXEMPLARY ACHIEVEMENTS

Since 1969, meeting the need for a visible, rational analysis of public involvement and the demands of a complex variety of Forest users has cost the Forest Service many man-years of effort. In meeting this need, many Forest officers have worked toward producing good analyses. Although issues discussed in this report indicate that deficiencies still exist, many units must be commended on the marked improvement in analytical processes and documents since 1973.

The review team was impressed that field units considered themselves a part of the review and participated in frank, honest, and candid discussions. This helped produce a report and alternative actions that will provide constructive improvement.

Representatives from Regions 1, 3, 5, 6, 8, and 9 worked long hours with the WO staff and contributed constructive suggestions to their analysis of findings and preparation of alternative actions.

The Malheur National Forest appears to be well organized to accomplish their program. The workload is handled on a project basis with the project coordinator following it from planning through completion. Most significant in this process, with respect to preconstruction activities, is the commitment to developing and following long-range resource plans. All specialists are assigned to zones. They then provide consultation and support to District Rangers and project coordinators. The Malheur National Forest has also developed a process for EAR's where management lists "musts" and "wants" and a project report is then written which evaluates how well the project can meet the listed needs.

The Deschutes National Forest has developed a two-phase engineering project report. Phase I provides a general analysis of how the project fits resource plans, and Phase II provides specific analysis and design criteria. This process appears to be working well.

The Ottawa National Forest has a good, cost-effective, "Compartment Plan" development process. In this process, the Ranger publishes a list of land compartments to be investigated during the following year. This list is reviewed by all specialists who might participate in the process. At the time of the compartment investigation, the Ranger uses all the specialists who have expressed an interest plus those that he feels he needs. As an important final step, he presents the plan orally to the Forest Supervisor and staff. This provides a much better review than passing the report between desks.

The Ottawa National Forest has a soils map prepared by the Forest's soil scientists and engineers which includes prediction of engineering properties by subjective evaluation. General engineering properties are included such as suitability ratings for dams, roads, permability, etc., in the form of "good," "fair," and "poor." This is a good reconnaissance planning tool, providing the user understands the limitations of the subjective evaluations.

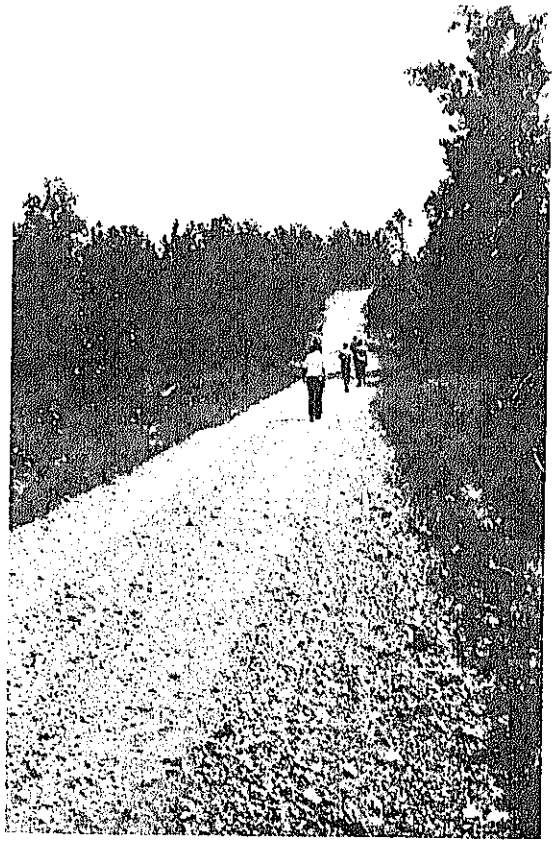


Figure 5. Camel Ridge Timber Sale Road, R-9.
A road on the Mark Twain National Forest in Missouri having adequate characteristics for harvesting the timber.

Regions 1, 5, and 6 have been conducting reviews or audits of preconstruction on selected projects each year during the last 3 years. The Region 1 and Region 6 checklists are good documents for review (these are not in the Appendix of this report but may be requested from the Regions).

The Lolo National Forest has an excellent handbook supplement concerning transportation analysis.

In all units, there appeared to be an acceptable verbal relationship between the District Ranger and preconstruction engineers. Considerable time was

often spent on the site to assure that the project and its design fit the needs of the resource. This interrelationship generally produced resource-supporting facilities that were adequate. However, this is not being done in a systematic manner and is not properly documented. Consequently, there is no way that we, the public, the courts, or Congress can review the action.

Figure 6. Collector Roads, R-9.
A collector road surfaced with crushed rock.

STATEMENT OF FINDINGS AND CORRECTIVE ACTIONS

This section deals with the aspects of the preconstruction activity that need correction and includes a list of actions planned for correcting each problem discussed. The findings list problems which need consideration on a national basis and may or may not apply to specific units.

ISSUE NO. 1: COMMUNICATIONS, ANALYSIS, AND OTHER DOCUMENTATION NEED IMPROVEMENT

General Discussion

Lack of understanding and faulty communications between management and engineers are causing many roads to be located in the wrong place or designed and built to the wrong standard.

When the relationships between resources and facilities are not adequately communicated between management, road locators, and designers, the Forest Service has unsupportable road standards. This lends itself to an "over-building" issue, even if there is no overbuilding. In this situation, there is no way for Forest Service officers, the public, the courts, or Congress to review the action.

The Activity Review Team recognized the importance of this subject and established assessment procedures to evaluate management direction and related analysis processes. Emphasis was given to the Environmental Analysis Report (EAR) and the relationship of Engineering Analysis to its contents.

Findings

1. A *written* evaluation relating road design criteria to resource management objectives was seldom found.

2. The directives system does not clearly define the relationship between EAR direction and design criteria.

3. There was little written documentation of efforts made to fit design criteria (technical and operational characteristics) with EAR direction.

4. Most projects had no documentation which related to the Forest Transportation Plan.

5. Many Forests felt that a Transportation Plan could not be made until the Land Management Plan was finished. These were scheduled from 4 to 15 years hence.

6. The EAR and supporting data were not done soon enough to allow a proper job of engineering analysis and still meet the due date.

7. EAR's and supporting documents did not have a cost/benefit analysis (including lost opportunities) for fisheries, wildlife, or scenic protection.

8. Many EAR's failed to discuss or analyze the "no go" alternative. This deficiency was found in cases where timber harvest plans required roads through areas where high costs and related high potential for environmental damage are involved with questionable benefits.

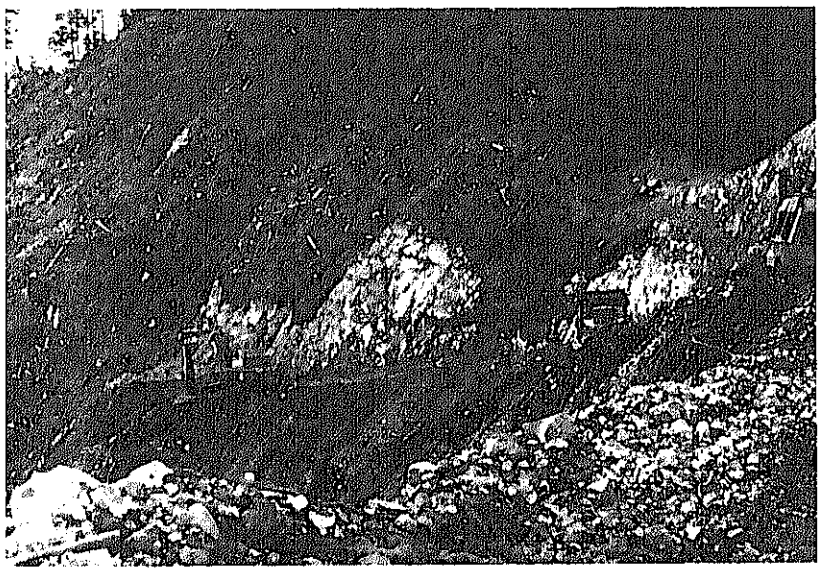


Figure 7. Butcher Gulch Timber Sale Road, R-6. This section of single-lane road cost $250,000 per mile. The Environmental Analysis Report did not discuss the consequences of not building the road.

9. Even though verbal communication between land management resource specialists and engineers was excellent, it did not provide an adequate analysis of engineering alternatives as they related to resource objectives.

10. Several Forest and Unit Plans had technical criteria which were either too specific or provided no realistic direction.

Figure 8. West Branch of Deerfield River Bridge, R-9. The cut slope does not meet the Forest's Plan requirements for maximum cut height. However, it probably is the best design for balancing grade, fill, and cut problems. This bridge replaces the one shown in figure 4.

11. Two projects involved unstable areas which were not discussed in any preliminary reports or documents. Another project involved pioneering by power-shovels to avoid sliver fills. This situation resulted in high costs not considered in the EAR analysis.

12. Analyses were not made to determine "design vehicle" criteria. As a result, roads were designed with a traveled way that had insufficient width to accommodate needed logging equipment.

13. Other findings indicate poor use of specialists compared to expected environmental impact, and a lack of survey, design, and geotechnical prescriptions.

Probable Causes

A test of the findings indicates that the most probable causes are the systems and procedures used, various supervisory actions, and inadequate training.

1. Directions given are vague and not related specifically enough to the project in question;

2. A process defining what is required is not in the directives system; and,

3. Knowledge of route and economic analysis and the relationship of environmental objectives to design criteria was lacking.

Problem No. 1

RESOURCE MANAGEMENT OBJECTIVES, TRANSPORTATION ALTERNATIVES, AND THEIR RELATIONSHIPS ARE NOT BEING ADEQUATELY ANALYZED AND DEFINED.

Corrective Actions

1. The Regional Foresters shall take action to require the Forests to relate transportation alternatives clearly to resource management objectives in the EAR process.

This shall be implemented immediately.

2. The Chief shall issue the necessary policy and detailed instructions in FSM Titles 7700 and 8400 to clarify the relationship between resource management objectives and transportation preconstruction alternatives.

The WO Engineering and Land Management Planning Staffs shall complete this by January 1978.

3. The Regional Foresters shall provide to the Forests the necessary training, target dates, and review to meet the requirements established in Action No. 2 above.

This shall be completed by January 1979.

ISSUE NO. 2: DESIGN PROCEDURES AND QUALITY OF DESIGN NEED IMPROVEMENT

General Discussion

This concerns a widespread and serious deficiency and requires immediate attention. These same deficiencies were observed in the "Overview of Timber Sales and Related Engineering Activity Review" of 1976.

The reviewers believe that a small increase in the quality of road design will generally eliminate many of the negative findings. It appears that line officers sometimes trade off quality engineering for production and ceiling goals by assigning poorly qualified designers to the design activity and reducing or eliminating journeyman designer review. When decision-makers dictate, or are willing to accept, designs that may not meet safety and environmental needs adequately, it should be identified in a decision analysis process and be well documented.

It is difficult to separate low quality design from other preconstruction activities or especially from construction engineering when reviewing a

completed construction project. This review has approached the problem by a careful study of the preconstruction documents, plans, and specifications, as well as an appraisal of the finished construction projects. The review team depended heavily on field comments in order to separate unrelated problems from the design process.

Design problems of particular concern include drainage design, cross-section width selection, and turnout locations. These did not make up a large part of the review findings and are considered of low to medium seriousness as related to the number of occurrences and severity observed during the review.

To compromise, overlook, or disregard identified safety requirements in road design may have serious consequences. Deficiencies can result in accidents which injure or kill people and damage property.

Unsafe conditions designed into a road are often expensive to correct. Unsafe design is generally more serious than the lack of, or misuse of, road appurtenances.

Findings

The findings can be summarized as follows:

-- Faulty analysis procedures have led to incorrect conclusions.

-- Conclusions and decisions are not supported or based on a documented analysis.

-- Use of people and/or procedures are not efficient.

1. Use of specialists is erratic and not well evaluated. Forest Preconstruction Engineers were asked to evaluate the impact of the project on the environment by assigning an "environmental impact" index to the project. A high expected impact on the environment is one indication of the need for specialists in landscape architecture, hydrology, wildlife, geotechnology, and other disciplines. However, a comparison of the assigned environmental impact index with the amount of specialist effort showed no correlation.

Reviews also showed that *none* of the project documentation indicated a need for specialists, yet specialists were often used and their costs ranged from 0 percent to 10 percent of direct preconstruction costs.

2. Some projects use expensive data collection procedures. The line graph in the Appendix plots project construction costs against preconstruction costs expressed as a percent of construction costs for the 29 projects reviewed. This graph indicates two things:

(a) When total project construction costs are less than $50,000, we can expect a rapid increase in the preconstruction cost on a percent of construction cost basis.

(b) Those projects below $50,000 total construction costs have a wide spread. It is possible that those points above the curve and below $50,000 construction costs are excessive.

3. There were indications that the use of computerized road design programs (RDS) and photogrammetry were rarely analyzed.

4. No project documents included an analysis that determined the least expensive survey method for the fiscal and environmental costs involved. The scope of the review did not permit an in-depth evaluation of the efficiency of the survey practices used.

5. In three cases, an economic analysis was made of several routes and a more expensive alternative was chosen without clearly justifying the extra cost. In one case, the route selected was not only more expensive but it was constructed near a stream where environmental concerns were greater than the discarded alternative.

6. In one Region, three out of four economic analyses were found to be in error. Benefits were duplicated and the repeated costs of bridge replacement in the "use of the temporary bridge" alternative were not included.

7. Temporary bridges instead of permanent ones were installed without economic analysis. This resulted in the construction of a temporary bridge that was only a few dollars cheaper than a preferred permanent bridge. In another case, when funds became available, a Forest then made an analysis that a permanent bridge was reasonable rather than having included the analysis in the original design.

8. There is an apparent tendency of some units to provide for environmental protection with little consideration of cost or benefits.

9. Sometimes Environmental Analysis Reports specify design details without a rational basis, such as road width. Design objectives would be more appropriate.

10. In several cases where District designers were used, there was a lack of journeyman review. In one case, redesign during construction was necessary (inadequate subsurface investigations); other cases resulted in unsatisfactory facilities such as insufficient cross-drainage, a native timber bridge abutment sill placed at streambed level, and a native timber bridge that had too short a span for the waterway.

11. Geotechnical investigations were not used where needed and resulted in costly design changes. Two instances involved rock excavation where little or none was anticipated. In one case, disposal of the rock resulted in a roadway section wider than designed.

12. "L" line survey before design is being used on some Forests. This is usually a more costly approach than using "P" line and has the negative effect of tending to limit the designer's choices unnecessarily.

Figure 9. Marias Timber Sale Road, R-1.
No geotechnical investigation was made during preconstruction. Common excavation was originally assumed for the design. Clearing was completed as required by the original design. When rock was encountered, the cut slope was steepened. This resulted in excess scarring and expensive excavation, giving an appearance of "overbuilding."

13. In two instances, Specification 36 was included in the contract to control reshaping and surface finishing during reconstruction but was not enforced. A later decision considered it unreasonable to require full compliance (removal of oversized material and adequate cross-drainage) for the amount of purchaser credits allowed. This should have been decided during selection of specifications.

14. Turnouts were spaced at the maximum intervals rather than at effective points. There were comments to the effect that the directives system guidelines on turnout spacing and geometrics need to be revised.

15. Roads were designed with a 10-foot traveled way (and sometimes a 12-foot width) when Regional experience indicated that logging equipment could not travel the road safely.

16. Two percent outsloping was used without proper consideration for the steep road grade. Drainage occurred along grade rather than outslope.

17. The present use of a (+) 16-foot-wide road does not appear to warrant a 32-foot-wide bridge. Future use remains somewhat in question. Preliminary notes on the location indicated a double-lane structure based on a projected ADT for 1991 of 98. Manual guidelines would permit a single-lane width for an ADT of 98.

18. Unqualified designers were used in some cases.

19. Recently paved single-lane roads were open to unrestricted traffic without proper signing and turnout design.

20. Paved double-lane road with incomplete redesign or reconstruction of base resulted in unsafe curvature and superelevation for the higher travel speeds.

21. Single-lane bridge was feeding directly onto a primary facility without adequate storage for accessing traffic. Also, sight distance was reduced by trees and shrubs.

22. FSM 7720 requires that bridge traveled way widths be 14 feet for single-lane roads and 24 feet or greater for double-lane roads. One Region questions the restriction for sites where the existing road has a traveled way width between 14 and 24 feet on the premise that the bridge and road traveled ways should be the same to ensure safety. The other two Regions were satisfied with present direction.

23. Use of bridge hazard markers, bridge railing, and bridge approach railing is inconsistent or nonexistent.

24. Few traffic-control signs were designed or installed on projects visited.

25. Improper signing was found on recently built roads.

26. Guardrail ends were improper.

(The findings 19-26 are supported by problem discussions at the National Highway Safety and Signing Meeting held in Albuquerque, N.M., October 21-24, 1975. These are included in a "Proceedings" published by the Forest Service in January of 1976.)

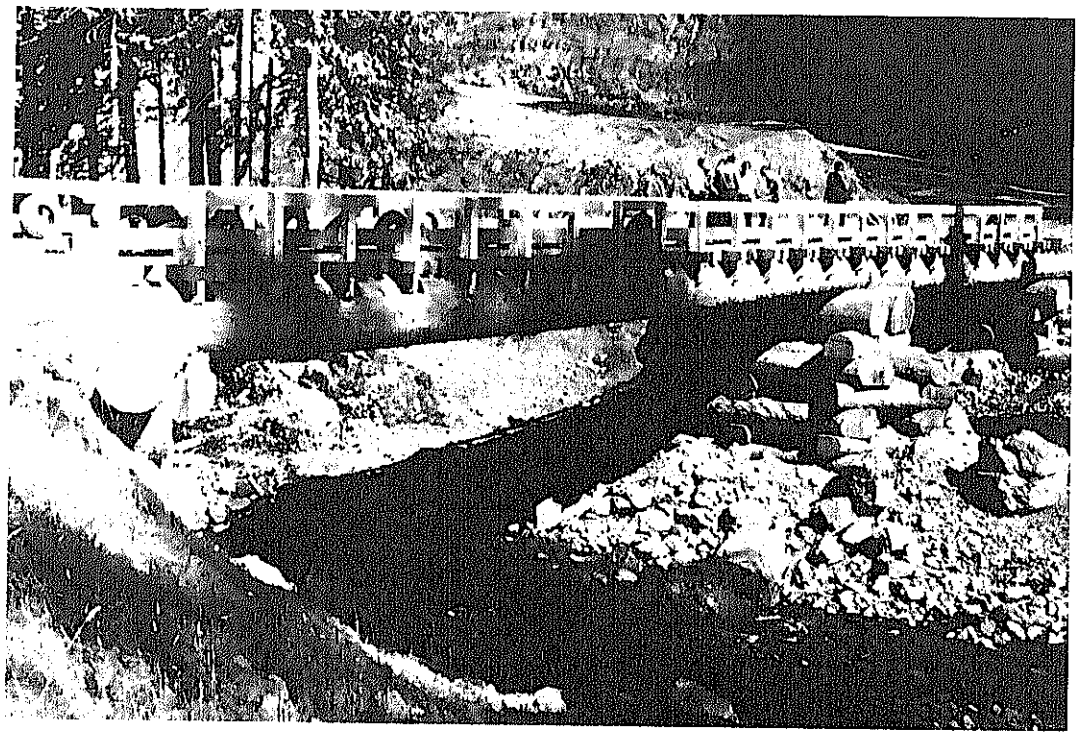


Figure 10. Little Nisqually Bridge, R-6.
Untreated "temporary" log stringer bridge, Gifford Pinchot National Forest.

Probable Causes

The most likely cause is that the requirements for individual design jobs are not adequately specified or supervised. Without specific requirements, knowledgeable critique of the design is, at best, difficult. It is also difficult to allocate time, skills, and funds realistically to provide a quality design.

There are indications that, in some areas, unskilled technical designers are operating with very little journeyman level review.

The most significant problem causes can be summarized as follows:

-- Inadequate design criteria (specific site criteria for designer).

-- Inadequate design procedures (procedural instructions and direction to designers).

-- Delegating design authority to lower administrative levels where skills do not exist and cannot be provided.

When any of the above exist, it has been shown that inadequate design will most likely occur. The problems can be reduced by providing better written instructions to the designer for specific project requirements and general design procedures. It is equally important to provide journeyman level review and guidance on a continuing basis with *full-time* responsibility for design.

The present Forest Service preconstruction handbook provides comprehensive direction. However, it is possible that certain generalized direction is not understood by the many technicians who have been assigned to design roads. Better written instructions and guidelines may be needed to serve these designers.

As a result of interviews with field personnel and based on statements relating to time pressures, the need to "get the cut out," and a perceived threat that detailed analysis will be required for every project, we conclude that there are significant external pressures causing field personnel to bypass requirements. Traditional ways of doing things also play a part.

There was also some indication that the importance of safety is not recognized. This was expressed by statements like, "why shouldn't they lose a few cars if they can't drive." This attitude must be changed.

Problem No. 2

THERE IS A SERVICE-WIDE WEAKNESS IN THE UNDERSTANDING, USE, AND DOCUMENTATION OF RATIONAL DECISION ANALYSIS, IN PARTICULAR, ECONOMIC ANALYSIS.

*Corrective Actions**

4. The Chief shall develop a decision analysis guide (with emphasis on economics) for use by preconstruction engineering personnel.

**Corrective Action numbers are sequential from Action No. 1, Problem No. 1;* *see page 31.*

The WO Engineering and Policy Analysis Staffs shall complete this by April 1978.

5. The Regional Foresters shall provide training and certification of preconstruction engineering personnel in applying the guide developed in Action No. 4 above.

This shall be completed by April 1979.

6. The Regional Foresters shall take action to require the Forests to use decision analysis principles (especially economics) in their preconstruction engineering.

This shall be implemented immediately.

Problem No. 3

INADEQUATE DESIGN AND DESIGN PROCEDURES HAVE CAUSED UNSATISFACTORY FACILITIES.

Problem No. 4

THE FOREST SERVICE IS DESIGNING AND BUILDING ROADS THAT CAN CAUSE UNACCEPTABLE INJURY AND PROPERTY DAMAGE TO USERS.

Corrective Actions for Problem Nos. 3 and 4

7. The Chief shall review and revise the FSM and Road Design Handbook as necessary to provide mandatory standards that are cost-effective.

The WO Engineering Staff shall complete this by July 1978.

8. The Chief shall issue a policy statement that requires the Forest Engineer to approve road and bridge designs as technically adequate before they can be constructed.

The WO Engineering Staff shall complete this by November 1977.

9. The Chief shall issue a policy that requires all road designs to be developed under the direct supervision of a designer certified in advanced road design.

The WO Engineering Staff shall complete this by January 1978.

10. The Regional Foresters shall perform annual activity reviews of a representative sample of road design projects. These shall include an evaluation of the technical supervision and critique provided.

This shall be implemented by November 1978 and continue indefinitely.

11. The Regional Foresters shall require that Forest Engineers perform an activity review of a representative sample of road design projects each year.

This shall be implemented by November 1977 and continue indefinitely.

Figure 11. Arterial Timber-Recreation Road.
An example of a high-standard, paved, all-purpose road.

ISSUE NO. 3: MANAGEMENT ACTIVITIES THAT AFFECT PRECONSTRUCTION PRACTICES NEED IMPROVEMENT

General Discussion

Purchaser Credit Use

A general overview of timber sales and related engineering activities was made in 1975 by the Washington Office. The review found that purchaser credits were sometimes used to improve or construct roads to standards that were in excess of individual sale needs. Consequently, the preconstruction activity review was directed to evaluate the use of purchaser credit further.

Use of Preconstruction Funds

An analysis was made of actual charges to preconstruction funds compared to miles constructed over the 3-year period, FY 1973-1975. This was compared to direct costs obtained from projects visited during the preconstruction review.

Directives System

A primary assignment of the Activity Review Team was to determine if national, Regional, and Forest directives material is adequate to ensure that a facility meets management objectives. This evaluation was accomplished by reviewing pertinent manual and handbook material. Emphasis was given to locating gaps or overlaps. The team also examined field use, attitudes, the system's usefulness, and whether too much or too little is written.

National Direction on Road Funding

Concern was expressed by field units that constraints being placed on the budgeting and planning process contribute significantly to inadequate design.

Estimating for Emergencies

Emergency and special fund programs such as ERFO usually have significant variations between preliminary and final project estimates. The time demands are a major factor.

Findings About Purchaser Credit

1. Haul was allowed over a poorly constructed road in one sale while plans were made to improve the road with timber sale credits on a second similar sale.

2. Discussions with some field personnel indicated that they did not fully understand the requirements of PL 88-657.

3. A double-lane road, including scenic view and recreation turnouts, was surfaced using timber sale credits.

4. The high cost of structures constructed for questionable fish habitat value may not be justified using timber purchaser credits.

5. A longer, significantly more expensive route than needed to harvest the sale was constructed from timber purchaser credits. The route also provided access to a Forest Service work center.

Findings About Use of Preconstruction Funds

1. The three Regions investigated show cost per mile as follows:

Region	Preconstruction direct costs	Preconstruction costs as charged (obligations)	Average construction cost/mile
1	$1,800/mi	$6,800/mi	$12,000
6	$2,100/mi	$2,600/mi	$19,000
9	$4,700/mi	$11,500/mi	$11,000

Direct Costs are the costs of labor, equipment, and materials used directly on the preconstruction job. These costs were reported by the Forests on 10 to 12 projects per Region.

Costs as charged - This is the sum of the obligations in Design (.27 funds) and Survey (.28 funds) as reported to the Washington Office and costs expended by timber purchasers for this item. The sum was divided by the miles of road constructed and reconstructed during the same 3-year period as reported by the Regions.

Average construction cost/mile - This is the total of the funds reported as spent for construction or reconstruction, divided by the total miles reported as constructed or reconstructed during the periods.

In summarizing this data, it was found that certain Forests had charged ".27" and ".28" funds to the extent of $13,300 and $45,700 per mile above the direct costs. This is 400 percent and 1210 percent, respectively, of direct costs. Others in the sample were also high.

It should be emphasized that the method of reporting "miles constructed" varied with Regions and may be in error. Therefore, the obligations per mile are not specifically correct. The range of charges, however, are accurate enough to indicate a serious problem during the fiscal years 1973-1975.

Findings About Directives System Use

1. Regional supplements to FSM 7720 and FSH 7709.11 contain many instances of conflicts, duplication, rewording, and improper designation.

2. Guidelines cited by the directives system require bridge railing, approach railing, and bridge hazard markers. Lack of these was noted in all Regions. Reasons for non-use include vague direction, designer decisions that appurtenances were unnecessary, and unfamiliarity with guidelines.

3. All three Regions have authorized Forest Supervisors to approve grades over 8 percent. Two Regions set maximums (15 percent and

18 percent). One Forest Plan allows grades in excess of the Regional maximum.

4. Chapter 70, FSH 7709.11, requires that culverts for cross-drainage shall be 18 inches or greater. One Forest consistently uses 15-inch cross-drainage.

5. Washington Office was slow to prepare or had prepared incomplete material.

6. Field comments include:

   (a) Too much detail in manual. Restrict to policy.

   (b) Do not have time to read and become familiar with directives system.

   (c) Direction which should be placed in the system is being distributed by memorandum.

   (d) Concerning rewording and duplication--"Forests are more inclined to follow direction if it is emphasized by the Regional Forester."

   (e) Update and retain FSH 7709.11. Use as a guide and for training.

   (f) Need more guidelines on traffic and road management.

   (g) National direction has the least influence on field work. The closer the generator of direction is to the project, the more influence the direction has.

   (h) Commitment to the directives system is not very good. Directives seem to be used only when they serve the user's purpose, usually either from a position of accusation or justification.

Findings About National Direction on Road Funding

1. 1973 Congressional direction and OMB funding caused many timber producing Forests to use "purchaser survey." The Forests were then able to utilize the freed appropriated funds and Forest Service ceilings on other work.

2. An additional short-range benefit of the "purchaser survey" option was the delayed need for design work on these projects.

Figure 12. Unsafe, single-lane bridge.
An example of unsafe bridges which are unsigned and remain open to the public.

3. Serious impacts will arise during the "catch-up" phase which we must go through as we implement Section 14(i) of the National Forest Management Act of 1976. The Forests now have direction to eliminate "purchaser engineering work except where justified." They must also be prepared to construct by formal contract any timber sale roads which cost more than $20,000.

4. Forests which have current contracts that include purchaser survey or deferred engineering must meet those engineering obligations and must also perform *all* preconstruction engineering prior to contract on future sales. As a consequence, the workload will be nearly doubled for the same output for the next year or two.

5. Congress has exercised its authority to "manage" timber purchaser credit financing. The controls established in this area require less purchaser construction and more public works contracting. This will also affect the preconstruction job.

Findings About Estimating for Emergencies and Special Funds

1. Lack of understanding or documentation of the conditions required to make a project available for ERFO funds. Resulting designs may have exceeded limitations for ERFO funding.

2. An ERFO project had an initial program estimate of $30,000 and the final cost exceeded $500,000.

3. An ERFO project for a stream crossing was programmed at $15,000 and then increased to $48,000 during final design because of added work.

Probable Causes

A test of the findings indicates that system and procedural actions, various supervisory actions, information flow, and lack of training and accountability are the most probable causes for errors in using purchaser credits for Forest road construction. A wide variation exists in interpreting controls in PL 88-657 which naturally results in confusion with respect to "can do" and "can't do." Interpretations are scattered throughout the 2400 and 7700 manuals. Substantial rationalization is prevalent, especially in times when few, if any, appropriated funds are available for supplementation and pressures are heavy to meet output goals. In addition, there has been no concentrated effort to ensure proper training for all individuals involved in interpreting the direction.

The reviewers feel that the high costs per mile for preconstruction engineering can be primarily explained by one or more of the following:

1. ".27" and ".28" funds could have been used for work remotely related to a project such as planning, receptionist services, radio investments, etc. (a fiscal problem).

2. Crews were assigned to do reconstruction engineering on many miles of road that were never built (a management problem).

3. During this period, a Forest or Region invested in capital investments, such as materials testing equipment, that caused extra costs (not a problem).

4. During this period, preconstruction engineering was being done on extra miles of road in preparation for an increase in the construction activity (a problem if in excess of Chief's direction).

The findings indicate that the directives system is too complicated, too burdensome, and often ineffective. The most probable causes are the directives system itself, the employee himself, systems and procedures, various supervisory actions, lack of accountability, and information flow.

The directives system is not being written, maintained, and used as intended. It is often ignored or misinterpreted. Efforts to keep it current have not been sufficient. Individuals are not exerting the vigorous, continuous effort needed to become familiar with the system, to insist on changes where needed, to remain abreast of the changes, and to use the system as intended. Many writers contribute to the system and, therefore, the levels of experience in handling the subject matter and the quality of the writing are not consistent. Too frequently, direction which should have been in the system is sent out by memorandum or other means.

The net result of the shift from "purchaser engineering" and some deficient preconstruction program planning is an increased preconstruction workload required to maintain existing production goals. A swing of emphasis from preconstruction to construction control has also contributed to the problem. *It should be stressed, however, that there are no indications that construction control is overemphasized.*

Better estimates are needed to assure that programing for emergency and special projects is adequate. Use of both resource and engineering specialists is necessary to achieve an understanding of project complexity. More careful investigation in preparing initial estimates and then revising estimates when additional data are available will do a lot toward improving the accuracy. There are also indications of a lack of understanding by higher level officers of the process and time necessary to make a good estimate, particularly under emergency or special conditions. Estimates for ERFO projects have to be compiled under adverse situations, usually prior to any environmental or on-the-ground assessment. Field personnel have been asked to submit proposals for so many uncertain programs that there is a tendency to treat the initial planning and estimating lightly. Unfortunately, some of the programs become a reality and use highly inaccurate estimates. Crisis events generate crisis estimates. To resolve this problem, program management procedures need to recognize the efforts involved in estimating and the several stages of estimating refinement that may be required.

Problem No. 5

NUMEROUS INCONSISTENT USES OF PURCHASER CREDIT CAUSE QUESTIONABLE ROAD FINANCING PRACTICES.

Corrective Actions

12. The Chief shall review and revise FSM Titles 2400, 6500, and 7700 to conform to PL 88-657. Action shall be coordinated with the National Forest Management Act of 1976.

The WO Engineering, Timber Management, and Fiscal and Accounting Staffs shall complete this by January 1978.

Figure 13. Single-lane paved road.
An example of an esthetically pleasing single-lane paved road.

13. In any relevant Fiscal, Timber, or Engineering activity reviews, the Regional Foresters shall include the use of timber purchaser credits as a review item.

This shall be implemented immediately and continue indefinitely.

Problem No. 6

THE EXPENDITURE OF PRECONSTRUCTION ENGINEERING FUNDS, AS SHOWN BY YEAR-END OBLIGATIONS, EXCEEDS DIRECT EXPENDITURES FOR SURVEY AND DESIGN BY A SIGNIFICANT AND UNEXPLAINED AMOUNT.

Corrective Actions

14. The Regional Foresters shall take action to assure that preconstruction funds are used effectively to meet National Direction. This concern shall be addressed in all relevant activity reviews.

This shall be implemented immediately and continue indefinitely.

15. The Regional Foresters shall sample the Forests and identify how preconstruction FR&T funds are being expended.

This shall be completed by January 1979.

16. The Chief shall establish, possibly through the PAMARS System, an accounting procedure which identifies the various elements of preconstruction engineering by project.

The WO Engineering and Program Development and Budget Staffs shall complete this by July 1979.

Problem No. 7

THE DIRECTIVES SYSTEM FOR ROAD AND BRIDGE PRECONSTRUCTION IS OFTEN IGNORED AND MISINTERPRETED AND DOES NOT ALWAYS MEET FIELD CONCERNS.

Corrective Actions

17. The Chief shall remove inapplicable non-policy material from FSM 7700 and coordinate with other FSM Titles as necessary. FSH 7709.11 shall be revised to reflect this change.

The WO Engineering Staff shall complete this by January 1978.

18. The Regional Foresters shall review and revise Regional FSM and FSH supplements to correspond with the revisions in Action No. 17 and to eliminate duplication.

This shall be completed by July 1978.

19. The Chief and Regional Foresters shall strengthen the use of, and commitment to, the directives system by emphasizing specific functions, such as:

    a. Reviews, audits, and functional assistance trips,

    b. Training plans,

    c. Monitoring performance evaluations.

This shall be implemented immediately and continue indefinitely.

Problem No. 8

IT WILL BE EXTREMELY DIFFICULT TO REDUCE THE DEFERRED SURVEY AND DESIGN BACKLOG AND STILL MAINTAIN EXISTING PRODUCTION GOALS.

In FY 1977, budgets have been adjusted to meet the concerns expressed here. Regions may have problems in securing manpower or in managing consultants to use the financing, but availability of funds should no longer be a problem. In view of this new situation, no action statement is needed.

Problem No. 9

CRISIS PLANNING FOR PROJECTS TO BE FINANCED WITH EMERGENCY FUNDS OFTEN RESULTS IN UNDERESTIMATED COSTS.

Corrective Actions

20. The Chief shall develop direction which gives emphasis to the time, processes, and estimating stages needed to arrive at accurate cost information for special programs.

The WO Engineering and Program Development and Budget Staffs shall complete this by April 1978.

21. The Regional Foresters shall develop an action plan which identifies processes for estimating costs of repairing road and bridge damage caused by natural disasters, such as floods, fire, earthquakes, etc.

This shall be completed by January 1978.

APPENDIX

Activity Review of Servicewide Preconstruction Engineering Practices

1976-1977

THE OVERBUILT ROAD ISSUE

Increasingly over the past decade, the Forest Service has been accused of "overbuilding" roads. Comments and allegations have been made through all levels of communications, hearings, on the Congressional floor, meetings, correspondence, and private discussions. The Forest Service has generally responded by refuting the allegations or intimating that a better job would be done in the future. "Overbuilding" means different things to different people. It can be described as a road condition which the observer considers too expensive or having too great an impact on the environment. In the "purchaser's" eye, road surfacing may be "excessive" while the conservationist would perceive the same road as "overbuilt" because of damage to the visual resource. An analysis might show that the road necessary to serve the resource adequately was designed and constructed with an optimum balance between costs and environmental damage.

The Chief recognized the Activity Review of Road and Bridge Preconstruction Engineering as an opportunity to investigate the issue and directed the review team to include it in their plan. Also treated are facilities considered by the team to be "underbuilt."

Discussions of the issue were primarily with Forest Service personnel but also included two representatives from the timber industry, a county official, and a road contractor. The Reviewers found a great deal of divergence in the meaning intended. Specific examples of "overbuilding" were construed to mean:

1. Restrictive slash disposal requirements on roadway clearing.

2. Requiring surveys of a class higher than flag lining for purchaser-engineered roads.

3. Requiring compaction of roadway fill.

4. Requiring end hauling to avoid exposed and erodable fill slopes.

5. Use of permanent bridge materials instead of logs or railroad car undercarriages.

6. Requiring culvert placement with tight specifications (compaction, alinement, and grade).

7. Including traffic control (gates, signs, etc.) in contract.

8. Requirements for protection of resources (fish passage, erosion control, visual, water quality).

9. Requiring asphalt pavement.

10. Excessive roadway width.

11. The road makes too big a scar on the landscape.

Of these examples, slash disposal, compaction, and visual impact seem to cause most of the complaints. Width of the travelway was sometimes criticized as too narrow as well as too wide. A cause unrelated to design is that purchasers often construct sections of a road to a width greater than that shown on the plans and with tacit approval of the Forest Service. The material and construction equipment make it easier to do this than maintain the design width.

Discussions with non-Forest Service personnel were as follows:

-- Pat Wheeler; Hines Lumber Company, Burns, Oregon:

Paving is cost-effective for the timber purchaser but (as a private citizen) believes that it is a waste of taxpayers' money. Dislikes paving because it increases other traffic on timber haul roads and increases vandalism of his equipment.

Agreed that lime treatment and rock surfacing were necessary for a wet section but believes that a cement base treatment on another section to be "overbuilding."

Probably should have 12- to 14-foot traveled way. Could use 10 feet with turnouts and the right kind of ditch. Likes shallow ditches so that trucks can use them for passing in lieu of traveled way width or turnouts.

-- Dale White; County Judge, Harvey County, Oregon:

Considers "overbuilding" to mean anything that cuts down the money returned to the counties. Cited paving and double-lane roads as examples. Receives pressure from local taxpayers when Forest Service constructs better roads than the county.

-- Jim Izett; South Coast Lumber Company, Brookings, Oregon:

Is concerned about paving because of the increase in recreation traffic and vandalism. Says that gates and watchmen have greatly reduced theft. Believes most roads need only crushed surfacing.

Is satisfied that compaction is necessary but that 100 percent disposal of clearing debris is not necessary. Should do more scattering.

Believes that construction staking is not too important. "Neither cat skinners nor inspectors know or pay much attention to what is written on stakes."

Wonders why the volume of specifications has grown over the years. One or two pages were all that were necessary years ago.

Have conquered the width problem. Tried to construct roads too narrow for equipment.

Would like to see either the purchaser or the Forest handle all of the preconstruction engineering. Does not agree with splitting it up between survey and design.

The reviewers observed a spectrum of design and construction from the very minimum of ground disturbance to what is effectively a continuation of a State secondary system.

Specific examples of the reviewers' findings of overbuilding are as follows:

-- Two-lane bridge constructed with FR&T funds. Analysis was made to determine whether proposed bridge should be double-lane rather than single, but analysis was not made to determine if Forest Service should build a bridge in the first place. Analysis showed that most of the traffic was public service and, further, that the small volume of timber involved could be hauled over another route at a lower total cost.

-- For purposes of fish passage, an open bottom arch was installed in lieu of a much smaller pipe. This was installed by purchaser. The location is near the upper limits of the drainage and the reviewers question the value of the drainage above that point as a fishery resource. The analysis should show the difference in cost of the two facilities as measured against the length of stream involved, as well as a survey of the stream to determine if any natural blockages exist.

-- Paved 16-foot-wide travelway for a single-lane road constructed with FR&T funds. A 14-foot travelway should have been used.

-- Several miles of double-lane road and bridge constructed with FR&T funds. Analysis does not clearly support double-lane.

-- Road and bridges constructed by purchaser. Route analysis indicates that timber could be harvested at significantly less cost over

another existing road. Decision was made to construct the road and bridges to make the area more accessible to work center.

-- Bridge with travelway of 32 feet on a (+) 16-foot road. Present use does not warrant double-lane and future use remains in question. Materials were furnished by the Forest Service and installed by purchaser.

Specific examples of underbuilding are as follows:

-- In an effort to design and build the "minimum impact" road, several Forests have constructed facilities with widths and alinement which restrict safe and efficient use to smaller trucks and preclude movement and operation of logging equipment needed to operate timber sales as designed.

-- Because of efforts to minimize reconstruction, overall transportation costs (including haul and maintenance) are higher than necessary. In many cases, simple activities such as removal of large rocks in road surfaces, and clearing of brush for safe sight distances were not considered. These could have increased haul speeds from 5 to 10 mph to 25 or 30 mph.

-- Reducing construction costs by wide spacing or lack of cross-drain culverts is causing serious erosion and maintenance problems in some areas. This is also occurring with the use of steep grades.

-- Temporary native log bridges are being constructed to reduce immediate costs. The structures were frequently inadequately designed for the site. Long-term costs are higher than necessary.

-- Provisions for stabilizing road surfaces in water resource zones are omitted.

All of the projects reviewed were "justified" for such reasons as environmental concerns (fish passage, control of dust, erosion), administrative needs, cooperation with towns and counties, and timing. (Contract requirements, programs, and other problems were blamed for lack of refinement on designs.) Some of the facilities, in the reviewers' opinion, were overbuilt; some were also underbuilt. The majority of the facilities were constructed to the appropriate standards that will meet traffic needs and protect environmental concerns. If there is any tendency, it is, in the reviewers' opinion, toward underdesign and construction. There is room for improvement, and steps to do so are in the appropriate action plans listed in this review.

The implementation of the *National Forest Management Act* and the *County Receipts Act* should reduce the number of complaints in that the funds returned to the counties are no longer dependent on the purchaser credit

allowance for roads. Also, there should be a significant reduction in the miles of road constructed by the purchaser and a corresponding increase in the miles of road constructed by public works contract.

RECENT AUDITS AND INSPECTIONS

Several audits and inspections have been performed in CY's 1975 and 1976 which have dealt, in part, with preconstruction engineering. Following is a list of those discussed here:

Overview of Timber Sale and Related Engineering Activities (Regions 1, 2, 3, 4, 5, and 6)	*1/20/76*
Audit Report No. 60311-6-SF (Region 6)	*1/26/76*
Audit Report No. 831-13-SF (Region 1)	*7/18/75*
Audit Report No. 831-14-SF (Region 2)	*9/3/75*
Audit Report No. 831-15-SF (Region 8)	*6/2/76*

A summary of findings related to preconstruction engineering which are contained in the above documents follow.

EAR PROBLEMS

(Audit R-8)--EAR's were lacking and timber sale planning was not far enough ahead to contribute effectively to program planning and budgeting.

(Audit R-2)--Management direction must be written and followed through. (This finding generated the following recommendation):

> *Require that management requirements and constraints developed in the Environmental Analysis Report be covered in the timber sale contract.*

(Audit R-6)--One Region is planning a complete overhaul of the EAR development system in response to nonuniform and tardy reports.

(Overview)--Need better long-range planning/project planning integration. Reconnaissance effort must be emphasized.

(Overview)--Management objectives and resource prescriptions need to be improved and communicated to preconstruction people.

(Audit R-6)--Inventory records not up to date are causing some specified roads which are not on the system to be built illegally with road credits.

ECONOMIC ANALYSIS AND PURCHASER CREDIT PROBLEMS

(Audit R-6)--Principles and procedures for performing economic analysis, selecting road standards for timber sale roads, and assuring compliance with PL 88-657 are being reviewed critically and updated.

(Audit R-6)--The National Forest Management Act of 1976 requires further revision of existing policies and procedures.

(Overview)--A deficiency was noted in economic analysis and in financial planning.

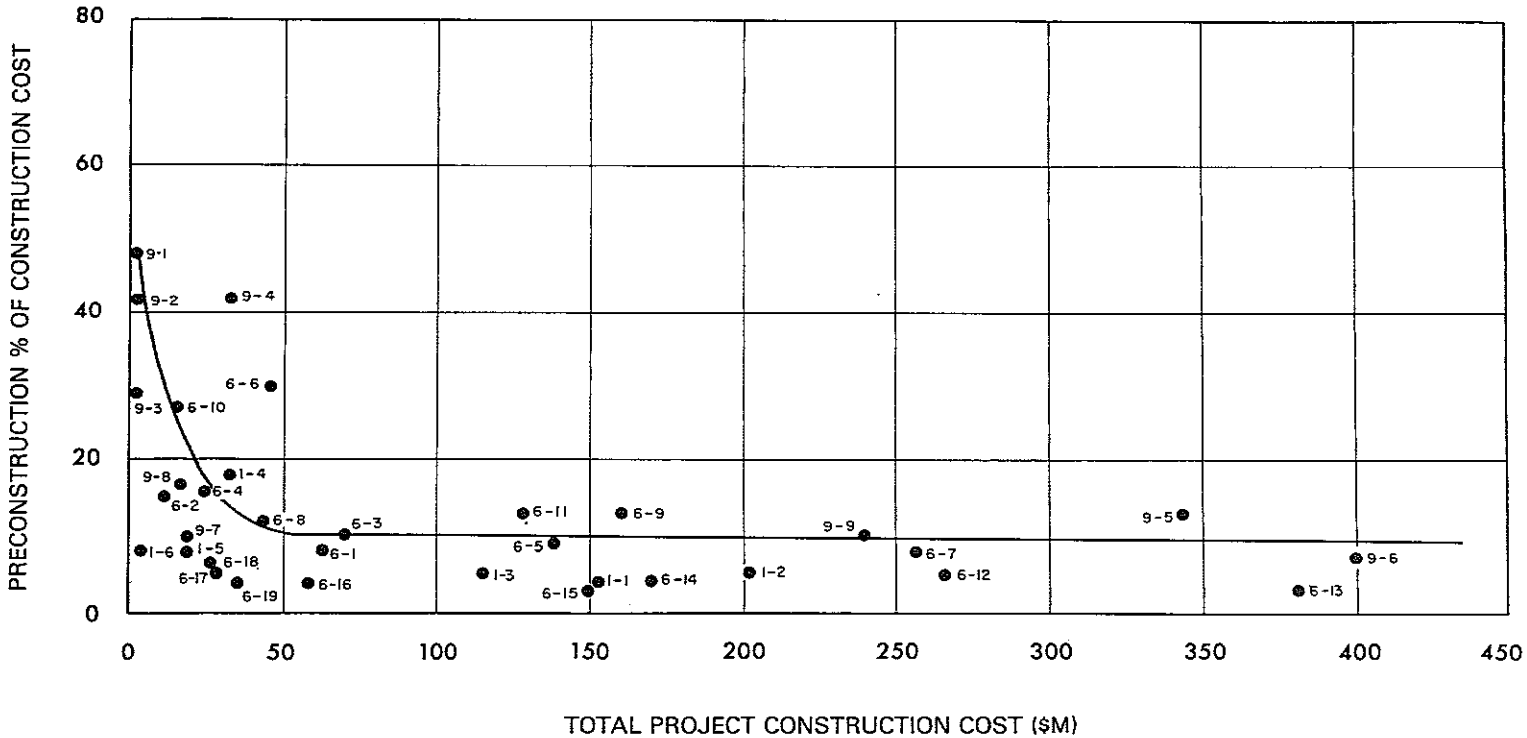
HIGH OBLIGATION OF PRECONSTRUCTION FUNDS

(Overview)--Organization has grown in size and complexity. Environmental concerns require the employment of additional specialists. (It follows that it takes more preconstruction dollars to finance a larger organization, hence higher unit costs or higher overhead costs.)

OTHER PROBLEM AREAS SPOKEN TO

(Overview)--What is a minimum impact road? It is different things to different people. The term needs to be clearly defined.

(Audit R-6)--The most common deficiency noted was inadequate documentation of the problem solving/decisionmaking process.



Comparison of direct cost of preconstruction as a percent of construction cost to project construction costs for projects investigated by review team.

CHECKLIST USED BY REVIEW TEAM

FOR

ASSESSING PROJECTS, FORESTS, AND REGIONS

SUMMARY ASSESSMENT

ROAD AND BRIDGE PRECONSTRUCTION REVIEW

Region _____ Project _____

Forest _____ District _____

Use

1. The attached worksheet will be used to summarize evaluations of each project by the review team.

2. While the form may be completed separately by individuals and for each review phase (i.e., Office and Field), the final assessment from the Office review and Field review will be placed on the same form in columns 2 and 3 with suitable remarks.

3. The "questions" have been limited and may require additional worksheets to provide an informed assessment (reviewers are developing these worksheets).

4. "Questions" will be changed if field conditions warrant.

5. The form may be used to indicate a Regional assessment by moving symbols from the project forms to a Regional assessment form.

6. The suggested analysis processes for FR&T funding analysis (under question No. 6) may not be pertinent in view of available information. These will be changed as better analysis processes are developed.

Instructions

Column 1. Self-explanatory.

Columns 2 & 3. Place a symbol at the location along the line which is the reviewers' best estimate of the rating as estimated by the analysis. Leave blank if analysis or observation provides no answer to question.

Column 4. Record important observations on reasons for rating.

Field Review

1. Investigation should be made to secure answers to questions brought up by the office review.

2. Field check should be made to assure that statements in EAR and Engineering report truly represent ground conditions.

SUMMARY ASSESSMENT

ROAD AND BRIDGE PRECONSTRUCTION REVIEW

Region _____ Project _____

Forest _____ District _____

Primary Question No. 1:
Are National, Regional, and Forest Directives consistent with and adequate to meet field practices and needs?

Assessment Process

1. OFFICE--Reviewers will review 7720 Section of manual and the Preconstruction Handbook. In addition, they should become familiar with important Budgeting and Programing and Timber Management direction concerning roads and trails preconstruction activities.

   This should be done before first field review.

2. OFFICE--Reviewers will read all Regional supplemental material.

3. OFFICE--For items 1 & 2 above, reviewers will list questionable items which should be checked in the field.

4. OFFICE--For situations where all Regional supplements provide the same direction, reviewers should consider and recommend whether this material should go in the national directives system.

5. OFFICE--Reviewers should watch for gaps or overlap between WO and RO manual direction and recommend adjustments as needed.

6. FIELD--Reviewers will review Forest supplements and note their adequacy and whether they cover gaps that need RO or WO direction. Also whether direction is appropriate.

7. FIELD--Reviewers should watch for gaps or overlap between RO and SO manual direction and recommend adjustments as needed.

8. FIELD--Reviewers will determine what field engineers, specialists, and line officers recommend should be in the directives system:

Is material appropriate?
Is there too much?
Is there too little?
Is the material used at all?

9. Final assessment will consider three evaluations:

   (a) How directives material supports the "doing" job.

   (b) How the different organization level policies relate to each other and what should be changed.

   (c) How manual direction relates to professional practices.

SUMMARY ASSESSMENT

ROAD AND BRIDGE PRECONSTRUCTION REVIEW

Region _____ Project _____

Forest _____ District _____

Primary Question No. 2:
Are management objectives sufficiently developed to use as a basis for guidance of facility preconstruction engineering activities?

Background

This question is to assess the adequacy of direction (steering) provided by management to the specialist so that the facility will be designed truly to meet management needs. It also assesses the responsibility of the Engineering team to determine what management wants (or needs).

An analysis process should include the project in an Environmental Analysis Review which is further coordinated with land use and resource plans in both the larger time and area dimensions. It should also include an evaluation of alternatives. Reviewers will review this process on each project.

It is recognized that management direction can be provided in writing or verbally or both. The reviewers will need to check both approaches.

Assessment Process

OFFICE--The Environmental Analysis Review (EAR), its relationship to an Engineering Report, and other plans are the basis of this assessment.

As related to the proposed Engineering facility:

SUMMARY ASSESSMENT
ROAD AND BRIDGE PRECONSTRUCTION REVIEW

Place symbol in proper column: *O = Office Review Assessment* *F = Field Review Assessment* *T = Total Assessment*	*RATING*						*REMARKS*
	Inadequate			*Adequate*			
	1	*2*	*3*	*4*	*5*	*6*	
1. Does the EAR demonstrate that the project and the facility are in accordance with guidelines and direction of: Land Use Plan? All Resource Plans Covering the Area? Transportation Plans?							
2. Has the EAR analyzed several alternatives with a final choice made by line officer?							
3. Do alternatives clearly show consequences and compare different choices so that they can be logically evaluated by the decision-maker?							
4. Does EAR discuss and evaluate costs and maintenance of the facility?							
5. If funding is not available for the full service facility, does the EAR provide direction on the tradeoff constraints for a lesser or alternate facility?							
6. Does the EAR give adequate criteria for the development of the facility?							
7. The "Engineering Report" is a preliminary technical analysis of the proposed facility which							

SUMMARY ASSESSMENT
ROAD AND BRIDGE PRECONSTRUCTION REVIEW

Place symbol in proper column: *O = Office Review Assessment* *F = Field Review Assessment* *T = Total Assessment*	*RATING*						*REMARKS*
	Inadequate			*Adequate*			
	1	*2*	*3*	*4*	*5*	*6*	
advises the line officer of the kind of facility that can be built to serve the given objectives; it provides cost, impact, and lead time information for evaluation. This report may be an Appendix to the EAR.							
Does the Engineering Report provide enough information so that the line officer can make a rational decision, including:							
Location Analysis Road Standard Analysis Preconstruction Engineering Methods Geotechnical Considerations and Probable Required Investigation Impact on Scenic View Impact on and Protection of Soil and Water Capability of Serving Resource Needs Plans for Minimizing Damage to Resources Relationship to Transportation Plan?							
8. Is there evidence that line officer and engineer reconciled points of difference between the objectives of the EAR and the proposed standard of the facility?							

SUMMARY ASSESSMENT
ROAD AND BRIDGE PRECONSTRUCTION REVIEW

Place symbol in proper column: *O = Office Review Assessment* *F = Field Review Assessment* *T = Total Assessment*	*RATING*						*REMARKS*
	Inadequate			*Adequate*			
	1	*2*	*3*	*4*	*5*	*6*	
9. Planning for organization and financing of preconstruction work are investigated under primary questions 6 and 7. However, the effort and lead time needed for preconstruction engineering shall be included in the Engineering Report. Is there evidence that, in the preconstruction engineering process, decision points were established for reevaluation by the line officer?							

SUMMARY ASSESSMENT

ROAD AND BRIDGE PRECONSTRUCTION REVIEW

Region _____ Project _____

Forest _____ District _____

Primary Question No. 3:
Is the design effective in meeting management needs and objectives?

Background

This question assesses professional and managerial interaction during the design process to assure that the design provides the required service along with protection to resources at a feasible cost.

Office and field reviews required to answer:

Place symbol in proper column: *O = Office Review Assessment* *F = Field Review Assessment* *T = Total Assessment*	*RATING*						*REMARKS*
	Inadequate			*Adequate*			
	1	*2*	*3*	*4*	*5*	*6*	
1. Did line officer review the design prescriptions and "steer" the process when major changes were necessary? Logical decision points where new information is available that could affect design prescriptions are: (a) After Reconnaissance and Location. (b) After a Geotechnical Investigation.							

SUMMARY ASSESSMENT
ROAD AND BRIDGE PRECONSTRUCTION REVIEW

Place symbol in proper column: *O = Office Review Assessment* *F = Field Review Assessment* *T = Total Assessment*	*RATING*						*REMARKS*
	Inadequate			*Adequate*			
	1	*2*	*3*	*4*	*5*	*6*	
(c) After a Preliminary Design Layout. (d) When any major changes become required during design. (e) After final design.							
2. Does the design meet the requirements established by the EAR and, if not, is there evidence that the change was made only after reevaluating original objectives?							
3. Does the design provide adequate structures for resource protection and use--including surfacing, sub-base, waterway, retaining walls, turnouts, access to landings, recreation area, and for fire attack requirements, signs, erosion control, sight distance, bridge, and culverts.							
4. Does the final facility serve the resource objectives set forth in the EAR?							
5. Does the facility provide more service than needed to meet management needs as set forth in the EAR and/or later revised?							

SUMMARY ASSESSMENT
ROAD AND BRIDGE PRECONSTRUCTION REVIEW

Place symbol in proper column: *O = Office Reveiw Assessment* *F = Field Review Assessment* *T = Total Assessment*	*RATING*						*REMARKS*
	Inadequate			*Adequate*			
	1	*2*	*3*	*4*	*5*	*6*	
6. For timber sale roads, does the final design and financing meet requirements of PL 88-657 (Prudent Operator Concept)?							
7. If purchaser facility is less than needed for long-term management, were actions taken to accommodate future needs?							

SUMMARY ASSESSMENT

ROAD AND BRIDGE PRECONSTRUCTION REVIEW

Region_____ Project_____

Forest_____ District_____

Primary Question No. 4:
Does the design cause problems in construction, operation, and maintenance of the facility?

This question usually must be answered by field review.

Place symbol in proper column: *O = Office Review Assessment* *F = Field Review Assessment* *T = Total Assessment*	*RATING*						*REMARKS*
	Inadequate			*Adequate*			
	1	*2*	*3*	*4*	*5*	*6*	
1. For roads, is the facility built wider than called for in the design? Why?							
2. Did design meet equipment and materials availability conditions in the area?							
3. Does design meet capabilities of construction equipment?							
4. Does design require extensive maintenance not available in practices of roadside clearing, ditch cleaning, erosion control, culvert cleaning, surface upkeep?							
5. Does design recognize capabilities of users' equipment and operating costs?							

SUMMARY ASSESSMENT
ROAD AND BRIDGE PRECONSTRUCTION REVIEW

Place symbol in proper column: *O = Office Review Assessment* *F = Field Review Asessment* *T = Total Assessment*	*RATING*						*REMARKS*
	Inadequate			*Adequate*			
	1	*2*	*3*	*4*	*5*	*6*	
6. Were facility management prescriptions realistic, as measured by actual use of facility?							
7. Does facility accommodate permitted use safely?							

SUMMARY ASSESSMENT

ROAD AND BRIDGE PRECONSTRUCTION REVIEW

Region _____ Project _____

Forest _____ District _____

Primary Question No. 5:
Does facility have components that are consistent?

Place symbol in proper column: *O = Office Review Assessment* *F = Field Review Assessment* *T = Total Assessment*	*RATING*						*REMARKS*
	Inadequate			*Adequate*			
	1	*2*	*3*	*4*	*5*	*6*	
1. Are geometrics of structure consistent with those of the road?							
2. Is bridge approach railing consistent with safety needs of site, traffic, and road?							
3. Are horizontal alignment and vertical alignment of roads balanced against each other and effective speed of vehicles?							
4. Does road surface match vehicle speed? Too smooth? Not smooth enough?							
5. Do sight distance, acceleration/deceleration lanes and road intersections fit speed and traffic characteristics?							

SUMMARY ASSESSMENT
ROAD AND BRIDGE PRECONSTRUCTION

Place symbol in proper column: *O = Office Review Assessment* *F = Field Review Assessment* *T = Total Assessment*	*RATING*						*REMARKS*
	Inadequate			*Adequate*			
	1	*2*	*3*	*4*	*5*	*6*	
6. Do turnouts fit design speed, traffic type, and volume?							
7. Are drainage facilities consistent with use of road (culverts, dips, outslope, etc.)?							

SUMMARY ASSESSMENT

ROAD AND BRIDGE PRECONSTRUCTION REVIEW

Region _____ Project _____

Forest _____ District _____

Primary Question No. 6:
Is the process of design efficient (cost-effective)?

Note: Primary Questions No. 6 and No. 7 involve two subjects: The allocation of FR&T funds for all purposes, and the efficiency of the design process.

Place symbol in proper column: *O = Office Review Assessment* *F = Field Review Assessment* *T = Total Assessment*	*RATING*						*REMARKS*
	Inadequate			*Adequate*			
	1	*2*	*3*	*4*	*5*	*6*	
FR&T Funding							
1. Is funds expenditure logical? For unit (usually a Forest), determine amount of funds allocated for preconstruction engineering for last 3 or more years, then equate that against number of road miles constructed per year.							
2. Are specialists funded and used appropriately for high priority jobs? Check kinds and number of specialists paid from pre-construction funds against what these specialists did or were assigned to do.							

SUMMARY ASSESSMENT
ROAD AND BRIDGE PRECONSTRUCTION REVIEW

Place symbol in proper column: *O = Office Review Assessment* *F = Field Review Assessment* *T = Total Assessment*	*RATING*						*REMARKS*
	Inadequate			*Adequate*			
	1	*2*	*3*	*4*	*5*	*6*	
3. Does Project Planning for funding fit actual later operations? Check source documents used to submit the Forest program and budget to the RO in 1973 or before. These should show exactly what facilities were to be provided preconstruction engineering. Then an assessment should be made to determine whether or not these facilities were actually worked on, and why. If source documents for items 1 through 3 above are not specific, determine if a recommendation is needed which requires more specific planning.							
4. Is the preconstruction engineering cost investment appropriate for the timber produced in the unit? In timber production units, divide the amount of timber produced in MM board feet by the cost of preconstruction engineering and check against other units and difficulty of preconstruction to determine a measure of efficiency.							

SUMMARY ASSESSMENT
ROAD AND BRIDGE PRECONSTRUCTION REVIEW

Place symbol in proper column: *O = Office Review Assessment* *F = Field Review Assessment* *T = Total Assessment*	*RATING*						*REMARKS*
	Inadequate			*Adequate*			
	1	*2*	*3*	*4*	*5*	*6*	
Design Efficiency							
5. OFFICE--Are the plans, estimate, and specifications adequate for construction?							
6. FIELD AND OFFICE--Is the direction from qualified Forest Service engineers to the working groups adequate?							
(a) For Consultant Contract or Timber Purchaser?							
(b) For Force Account?							
7. Procedure for Design:							
Choice of Design Method:							
Was an analysis made that listed alternatives for design and the consequences involved, and a conscious choice made in selecting the design method?							
Field Design Office Design by Computer Office Design by Hand.							

SUMMARY ASSESSMENT
ROAD AND BRIDGE PRECONSTRUCTION REVIEW

Place symbol in proper column: *O = Office Review Assessment* *F = Field Review Assessment* *T = Total Assessment*	*RATING*						*REMARKS*
	Inadequate			*Adequate*			
	1	*2*	*3*	*4*	*5*	*6*	
8. Was level of skill assigned adequate (or too high or too low)? (Note: Field design requires a higher level of skill with the field crew than the survey--Office Design Method.)							
9. Was the time spent by each skill level adequate (or too high or too low)?							
10. If changes in objectives and design direction were made during design, were they documented and rationally selected?							
11. Were analysis processes in accordance with good engineering practice?							
12. If a timber purchaser facility, was an analysis made to determine the investment that could be financed from the timber sale?							
13. Given above observations, was the design process cost-effective?							

SUMMARY ASSESSMENT

ROAD AND BRIDGE PRECONSTRUCTION REVIEW

Region _____ Project _____

Forest _____ District _____

Primary Question No. 7:
Are data collection and location activities efficient (cost-effective)?

Note: Primary Questions No. 6 and No. 7 involve two subjects: The allocation of FR&T funds for all purposes, and the efficiency of the design process.

Place symbol in proper column: *O = Office Review Assessment* *F = Field Review Assessment* *T = Total Assessment*	*RATING*						*REMARKS*
	Inadequate			*Adequate*			
	1	*2*	*3*	*4*	*5*	*6*	
1. OFFICE--Are Activity Reports adequate: Reconnaissance? Location? Geotechnical? Survey? Structure Site Survey and Data Sheets?							
2. Was direction provided by a qualified Forest Service engineer?							
3. Was review provided by a qualified Forest Service engineer?							
4. For work by Timber Purchaser or Consultant Contract, was:							

SUMMARY ASSESSMENT
ROAD AND BRIDGE PRECONSTRUCTION REVIEW

Place symbol in proper column: *O = Office Review Assessment* *F = Field Review Assessment* *T = Total Assessment*	*RATING*						*REMARKS*
	Inadequate			*Adequate*			
	1	*2*	*3*	*4*	*5*	*6*	
Contract Direction (specifications) adequate? Administration adequate? Final review and acceptance adequate?							
5. Were skills assigned adequate: Reconnaissance? Location? Geotechnical? Survey? Structure Site Survey?							
6. Was time spent during each activity by skills adequate: Reconnaissance? Location? Geotechnical? Survey? Structure Site Survey?							
7. Were procedures for data collection analyzed and consequences listed so that the level of precision and amount of data collected were prescribed to fit the product required?							
8. Were right-of-way needs recognized early and met without delaying the project?							
9. Was adequate lead time allowed?							

SUMMARY ASSESSMENT
ROAD AND BRIDGE PRECONSTRUCTION REVIEW

Place symbol in proper column: *O = Office Review Assessment* *F = Field Review Assessment* *T = Total Assessment*	*RATING*						*REMARKS*
	Inadequate			*Adequate*			
	1	*2*	*3*	*4*	*5*	*6*	
10. Was communication adequate between the line officer, the technical crews, and other specialists during, and at the completion of, each of the following activities? Reconnaissance? Location? Geotechnical? Survey? Structure Site Survey?							
11. Given the above observations, were the data collection and location activities cost-effective?							

WORKSHEET FORM FOR

LISTING PRECONSTRUCTION COSTS OF PROJECTS REVIEWED

INSTRUCTIONS FOR AN EVALUATION OF ROAD & BRIDGE PRECONSTRUCTION ENGINEERING OPERATIONS

INSTRUCTIONS FOR COMPLETING THE FORM

1. This form will be used to develop cost and preconstruction graphs for preconstruction operations at the Forest level. The information is to be collected from field practitioners.

2. Forest and Regional personnel are asked to provide suggestions about "other" information which could be used for this type of analysis.

3. A Preconstruction Engineer who is familiar with Forest area and operations should complete all blanks.

FIRST PAGE--LINE ITEMS

Lines 1 & 2 -- Self-explanatory.

Line 3 -- This is an index measurement of the difficulties of doing the survey because of topography intensity or ground cover, right-of-way problems, and similar conditions. The 1 to 9 index is used so that "5" is average. The index should be related to the engineer's knowledge of all survey conditions he has experienced, not just a Forest. On a statistical basis, only about 15 percent of the projects in the United States should fall below 3 and only 15 percent above 7. Consider this when filling out the form.

The field estimate will be compared against the WO reviewers' estimate which is based on a three-Region assessment.

Line 4 -- This is an index which evaluates the possible environmental damage which the facility could cause without careful design. It includes scenic view, fish and wildlife damage, fragile soils or cover, and similar biological and esthetic considerations evaluated as a totality under one index number.

See instructions under Line 3 for a discussion of the index numbers.

Line 5 -- Self-explanatory.

Line 6 -- Includes only direct cost, not additional assessments for overhead and program management.

Line 7 -- Check which process applies.

Lines 8 through 14 -- Calculate the ratios called for from information on page 1 or page 2.

REMARKS

List only statements about the project which explain unique situations.

PAGE 2

(An explanation of columns follows the explanation of lines.)

Line 1 -- Non-Engineering Specialists used in all activities below.

List the names of the specialists used and estimate their cost.

Line 2 -- Self-explanatory.

Line 3 -- Field Design. This is design done in the field while locating the road. No elaborate survey or office design is usually needed.

Leave blank if this activity was not done.

If this is completed, then lines 4, 5, and 6 are usually left blank.

Lines 4, 5, 6, & 7 -- Self-explanatory.

Line 8 -- Right-of-Way Cost. Show cost of right-of-way survey.

Line 9 -- Self-explanatory.

Line 10 -- Estimated Overhead Charge. This is to be shown in percent (%) and indicate the amount of charges against the project for overhead and program management. This will usually be the assessment calculated for charges against all funds on the Forest.

Column 2 -- For all activities listed, show the kinds of specialists used; i.e., for "surveying" one might show 1 party chief and 2 surveyors.

Column 3 -- Self-explanatory.

Column 4 -- Direct cost in total cost and cost per mile. This should be the engineer's best estimate of the cost of doing the job in 1975, under 1975 conditions and under the preconstruction policy of the Forest. It is not a listing to be taken from records.

Column 5 -- Effect index on activity step following:

Engineer should show an index number for his best estimate of how good or bad work in the activity will affect the activity step following.

For example: If it is felt that survey has a good effect on the capability of doing a good design job, then the index for survey will be at the 8 or 9 level.

Also, see Line 3 on Page 1 for a discussion of statistical meanings and concerns. It is possible that all indexes will be the same.

Column 6 -- Effect index on the long-range effect of the activity on the operations, maintenance, and reconstruction of the project.

See the Column 5 and Line 3, Page 1, explanations for this item.

EVALUATION WORKSHEET ROAD & BRIDGE

PRECONSTRUCTION ENGINEERING OPERATIONS

1. Project Name & No. _____ Region _____

2. Road Data: Length _____
   Width _____ Lanes
   Surface _____
   Other _____

3. Level of Survey Difficulty _____ (1 to 9) (9 is most difficult)

4. Level of Possible Environmental Damage From Facility _____ (1 to 9) (9 is most difficult)

5. Timber To Be Hauled Over Facility in Next 10 Years _____ MMBF

6. Cost of Construction _____

7. Construction by _____ Contract _____ Timber Sale

8. Ratio: Preconstruction Cost/Project Cost _____

9. Preconstruction Cost/MMBF of Timber _____

10. Preconstruction Cost/Mile _____

11. Survey Cost/Mile _____

12. Survey Cost/MMBF _____

13. Design Cost/Mile _____

14. Design Cost/MMBF _____

15. Remarks:

EVALUATION WORKSHEET

ROAD & BRIDGE PRECONSTRUCTION ENGINEERING OPERATIONS

Project Name & No. _____ Forest _____ Region _____

Develop data from documentation or best knowledge of Forest.

Activity	Kind of activity and list of specialists used	Date work completed	Direct cost [1]	Effect index 1-9 (9 highest)	
				On activity step following	On long-range effectiveness of project
(1)	(2)	(3)	(4)	(5)	(6)
Non-engineering specialists in all activities below			-		
Reconnaissance			-		
Field design			-		
Survey through X-section (not "L" line)			-		
Geotechnical			-		

[1] *Total cost*
cost/mile

Activity	Kind of activity and list of specialists used	Date work completed	Direct cost [1]	Effect index 1-9 (9 highest)	
				On activity step following	On long-range effectiveness of project
(1)	(2)	(3)	(4)	(5)	(6)
Design			-		
			-		
Sub-total preconstruction cost			-		
			-		
			-		
Right-of-way cost			-		
			-		
Total preconstruction cost			-		
			-		
Estimated overhead charge in %			-		

[1] *Total cost*
cost/mile

NOTES

NOTES

*U.S. GOVERNMENT PRINTING OFFICE : 1977 O-241-426/8